DEVICE FOR STACKING SHEET-SHAPED MATERIALS ON SHEET STACKS

Technical Field

The present invention relates to a device for stacking sheet-shaped materials on sheet stacks, and more particularly to a device for stacking sheet-shaped materials on sheet stacks found mainly in digital printing machines/copiers or in print further processing machines.

Background

In devices for printing and for processing printed materials, the print materials are stacked on a sheet stack in a large number of cases. In order to make further processing easier, e.g. binding a sheet stack of printed materials together to form a book or transporting larger sheet stacks, it is advantageous if the sheet-shaped materials form a sheet stack that is as square-shaped as possible, in which the side edges of the sheet-shaped materials lie exactly on top of each other. Typically, the sheet stack is aligned in different ways, in particular with straighteners that move the sheet stack, especially in the area of the topmost printed material, at regular intervals with an impact and usually align them against a stop.

Stacking sheet-shaped materials is understood here as when the sheet-shaped material is moved into a position in which it has no relative speed with respect to the sheet stack in transport direction, i.e., it is essentially at rest, but not yet necessarily aligned so that the side edges are even and not necessarily contacting the entire surface of the sheet-shaped material lying below it in the sheet stack. In the case described here, a sheet-shaped material is already considered stacked if its leading edge is not in contact with the leading edge of the sheet-shaped material lying below it, but the sheet-shaped material is no longer being transported and the majority of it is in contact with the sheet stack.

Typically, the sheet-shaped materials are processed individually and along a transport path in devices for printing and processing print materials, whereby the transport path lies essentially in the plane of the sheet-shaped materials. In order to form a sheet stack, the individual sheet-shaped materials are transported on a transport path, frequently laterally toward the sheet stack of sheet-shaped materials already stacked.

Alternatively to the option of ejecting the individual sheet-shaped materials directly over the sheet stack, as is typically the case with ejectors of printing machines, frequently the procedure is such, especially in digital printers or copy machines, that the leading edge of the new sheet-shaped material to be stacked comes in contact with the topmost sheet-shaped material in the sheet stack when it is being stacked and then is slid up to a stop over the sheet-shaped material lying topmost on the sheet stack. Then the sheet-shaped material can be aligned laterally, if necessary.

This process that is typical for the working sequence, especially of a digital printer or copy machine, involves a problem if it is a case of sheet-shaped materials that have a hole pattern, such as a 2, 3, 4 or 5 hole pattern used for storing sheet-shaped materials in binders or folders. On the other hand, it can also be a hole pattern that is made in the sheet-shaped material for a wire or plastic comb binding or a wire or plastic spiral binding.

In sheet-shaped materials in which such a hole pattern is provided, there is a possibility with a lateral placement method, in which the following sheet is slid with friction contact over the sheet-shaped material that is already stacked, that the hole pattern of the following sheet-shaped material or the corners of the following sheet-shaped material may catch in the holes of the hole pattern of the sheet-shaped material that is already stacked. It is especially easy for such catching to occur if the hole pattern involves a hole pattern for a wire or plastic comb binding or a wire or plastic spiral binding, since a hole pattern provided for this is generally arranged close to the side edges of the sheet-shaped material.

In particular, a “donkey ear” that is bent downward on a sheet-shaped material that will be stacked on a sheet stack of the same type of sheet-shaped materials gets caught in a hole of such a row of holes for wire or plastic comb binding or wire or plastic spiral binding if the side edges of the following sheet-shaped material are sufficiently misaligned in respect to the side edges of the sheet stack. However, such a misalignment can rarely be prevented completely when using paper guides.

An alignment of the sheet-shaped materials in the sheet stack so that the side edges are even can no longer be achieved if a corner of a sheet-shaped material catches in the hole pattern of a sheet-shaped material lying below it. This leads to the fact that the hole patterns in the individual sheet-shaped materials in the sheet stack are no longer aligned, which in turn has the consequence that a subsequent binding of the sheet-shaped materials using wire or plastic comb binding or using a wire or plastic spiral binding can no longer be carried out.

Therefore, it is desirable to have a device for stacking sheet-shaped materials that does not have the problems mentioned, especially when stacking sheet-shaped materials that are provided with a hole pattern.

A device is known from the German Patent DE 38 39 305 for stacking, in a stack, sheet-shaped materials that are supplied individually and above the stack. This device has a stop assigned to the leading edge of the sheet-shaped material, in the area of which a stapling device and a sheet stack removal device are arranged. Above the sheet stack and placed before the stapling device, when viewed in the sheet intake direction, there is a shaft that can be rotated in both directions by a stepper motor that is mounted perpendicular to the sheet inlet device and parallel to the top of the sheet stack. Separating fingers are mounted on the shaft that when lowered onto the sheet stack form a contact diagonal for subsequently incoming sheets and separate them from the sheet stack lying below them. If the sheet stack was taken from the collecting container, the separating fingers lay the sheets held back down in the collecting container by swiveling in the direction of the sheet intake. After stacking the sheets, the separating fingers continue rotating in the same direction of rotation until they reach the initial position

lying above the sheet stack. The task of the invention described in DE 38 39 305 is to design a device of this general type in such a way that free access is provided for further processing devices in the mounting area of the retainer device.

German OLS DE 23 63 224 discloses a spring-action, flap-type stacking element for a device which stacks sheet-shaped materials in a collecting shell, whereby the stacking element is mounted on a driven shaft and, after each sheet released into the collecting shell, it turns around the shaft in such a way that tension is initially built up in the stacking element and then released suddenly during further rotation and in this process the topmost sheet-shaped material lying in the collecting shell is driven against a stop.

Disclosure of the Invention

According to the present invention, a deflecting fin of a deflecting element lies, practically at all times, on the first sheet-shaped material lying topmost on the sheet stack in the area of the leading edge of the sheet-shaped material. In this case, the leading edge of the sheet-shaped material is understood to mean that outer edge that goes first in transport direction. The leading edge of a second sheet-shaped material that is transported laterally to the sheet stack is deflected upward by the deflecting fin. As soon as the second sheet-shaped material comes to rest, the deflecting element turns around its axis so that the deflecting fin is pulled out laterally from under the second sheet-shaped material and during further rotation a deflecting fin now comes in contact, from above, with the second sheet-shaped material in the area of the leading edge and remains there. This procedure repeats with each new sheet-shaped material transported for stacking. Because of the lateral removal of the deflecting fin under the leading edge of the sheet-shaped material, the leading edge drops vertically onto the leading edge of the sheet-shaped material lying below it. A catching of the corners of the upper sheet-shaped material in the holes of a hole pattern in the lower sheet-shaped material is virtually ruled out especially by this vertical movement. It is clear to the person skilled in the art that the number of deflecting elements can vary, this means that one, two, three, four or more deflecting elements can be used.

In addition, the material for the deflecting fin is selected in such a way that the upper side of the deflecting fin, with which the leading edge of a newly delivered sheet-shaped material is deflected, exhibits only little friction so that the newly delivered sheet-shaped material can be easily deflected; on the other hand, the bottom side of the deflecting fin exhibits greater friction with the sheet-shaped material lying below it. Because of this, the lateral removal of the deflecting fin carries the lower sheet-shaped material, as a result of the increased friction, forward against the stop and thereby providing additionally alignment. For example, this functionality can be achieved by a deflecting fin of spring steel with rubber coating on the bottom.

Also according to the invention, the sheet stack is limited in transport direction by a stop, whereby the stop exhibits a radius in the area of the upper edge of the stack of the stacked sheet-shaped materials opposite the transport direction. This stop is used as a limiter for the movement of the sheet-shaped materials during transport to the sheet stack. Alternatively, the stacking of the sheet-shaped materials on the sheet stack on a flat stacking element can be improved by using several, in particular two, stops.

Thus, if a sheet-shaped material lies with its leading edge on the deflecting fin in contact with the stop, most of the surface of this sheet-shaped material lies on a stacking element or the topmost sheet-shaped material of a stack that is forming on the stacking element. However, this also depends on the thickness, and thus the stiffness, of the sheet-shaped material, a thicker sheet-shaped material may not lie entirely flat on the deflecting fin but be deflected over its entire length. If the deflecting fin is now pulled out from under the next sheet-shaped material by rotation around its axis, the trailing edge of the sheet-shaped material ideally remains unchanged at its previous position and the previously deflected leading edge is gently lowered onto the stack of sheet-shaped materials. In this process, the leading edge follows with about the radius that is provided on the stop in this area. Lateral offset that would otherwise result by deflection of the leading edge, if this were deflected against a straight stop, is hereby prevented.

This means the radius stops the deflected sheet-shaped material before reaching the position that it would assume with a straight stop. Because of this, the trailing edge of the

sheet-shaped material comes to rest on the trailing edge of the sheet-shaped material lying below it and no movement opposite the transport direction is necessary during lowering of the sheet-shaped material. A movement such as this needs to be prevented especially when the incoming sheet-shaped material exhibits a hole pattern along its leading edge. In this process, a hole pattern consisting of a number of square holes, as is used for wire comb or plastic comb binding, is especially critical. These holes frequently have irregular edges that can catch on each other during lateral movements. If the holes of different sheet-shaped materials catch on each other, a matching alignment of all holes of the hole pattern in the stack is no longer possible in general. And if the hole patterns of the sheet-shaped materials in the stack do not match, it is usually no longer possible to implement a planned wire comb or plastic comb binding. Therefore, it is advantageous, particularly in the area of the leading edge, to stack such sheet-shaped materials very carefully and above all vertically without lateral displacements. This is achieved with this characteristic feature of the device according to the invention.

Also according to the invention, a deflecting element exhibits a structure that is essentially equal in area to that of the radius of the stop. This structure may be a leading edge stop that is provided on one side element of at least one of the deflecting elements.

By limiting the transport path by means of a stop, an advantageous alignment of the sheet-shaped materials is carried out at their leading edge. This is advantageous if it is a case where at least some sheets of the sheet-shaped materials have at least partially irregular outer contours, such as with register sheets or sheets with tab indents. In order to stack such sheet-shaped materials having irregular outer contours with side edges even at least in sections, these sheet-shaped materials have at least one straight side which for alignment can be guided at a stop and/or subsequently aligned with straighteners, in this case the leading edge of the sheet-shaped material. In most cases, register sheets or sheets with tab indents such as these have three common edges.

Also according to the invention, the stop is mounted so that it can swing downward so that laterally a transport path is released for a sheet stack of sheet-shaped materials stacked on the flat stacking element. This is advantageous if a set of sheet-shaped

materials was stacked into a sheet stack at the stop and now will be removed laterally as a stack, for example by an operator or by a further processing device such as a binding device for books. Sliding the stop in vertical or lateral direction or moving the stop from the lateral transport path by a non-swinging movement is also contemplated.

Also according to the invention, the deflecting fins are manufactured of an elastic material. It is possible to prevent the top sheet-shaped material from slipping due to pulling the deflecting fin out with respect to the position of the sheet-shaped materials lying under it by selecting a smooth, elastic material as the material for the deflecting fin, such as a spring steel or various plastics, and by ensuring that the movement is carried out with adequately high speed. In addition, the danger of damaging the sheet-shaped materials is considerably reduced by selecting an elastic, flexible material.

Also according to the invention, the deflecting elements have, on at least one side near the deflecting fins, side elements whereby the surface of the side elements is formed at least in sections in such a way that during rotation of the deflecting elements the surface of the side elements lowers the leading edge of the topmost sheet-shaped material onto the stack of sheet-shaped materials. A side element may be assigned to each side of each deflecting element. The side elements may be essentially disk-shaped, although star-shaped side elements are also conceivable. The side elements may be on the same axis with the deflecting fins. The side elements have surfaces that mostly match each other and thereby are similar to a roller cut into disks. The side elements may be manufactured of injection molding material and as much as possible are lightweight. For weight reduction, the side elements may exhibit concentric holes or a spoke-like structure. The side elements are provided perpendicular to the transport direction as uniformly and frequently as possible.

Also according to the invention, at least one side element exhibits a tab following the deflecting fin in the rotation direction of the deflecting element, the dimensions of the tab prevent the sheet-shaped materials that have already been stacked in the area of the leading edges of the sheet-shaped materials from spreading out. This tab may be formed

on all side elements. The tab ensures the spatial separation between the stack and an incoming sheet-shaped material in this area.

Also according to the invention, the surface of at least two side elements is formed in such a way that these serve, at least in part, as a vertical stop for the deflected sheet-shaped material. This prevents a possible upward spreading of the leading edges of the incoming sheet-shaped material, whereby stacking reliability is increased. As already described above, the side elements may have an additional arc-shaped leading edge stop that is essentially congruent with the radius of the stop a few 100 μm behind the radius of the stop in transport direction. Both vertical stop and leading edge stop are located in their operating position when the deflecting fin contacts the topmost sheet-shaped material in order to deflect an incoming sheet-shaped material.

Also according to the invention, the surface of at least one of the outer side elements is formed in such a way that in the area of the tip of the deflecting fin, the side element exhibits a recess. In this case, outer side elements are understood as the side elements that are at the greatest distance from the centerline of the transport direction. In another alternative embodiment, the side elements are always arranged in pairs around a deflecting fin, whereby the side elements placed closer to the centerline of the transport direction exhibit an upper stop for sheet-shaped materials, as was already described above, and whereby the other side elements in this area already have the recess. The recess is provided to prevent the outside edges from bumping into the side elements at this position during a lateral alignment of an incoming sheet-shaped material.

Also according to the invention, an alignment of the sheet-shaped materials is carried out by lateral alignment means. To do this, a first straightener and a second opposite straightener are mounted diagonal to the transport path in the flat stacking element, whereby the first and second straightener work together in order to laterally align the sheet stack that develops after a number of sheet-shaped materials are stacked. This aligning process may be repeated for each individual arriving sheet. The first or second straightener may be provided with elastic bristles that compensate elastic sheet tolerances during straightening. An alignment of the sheet-shaped material in the sheet stack with

side edges even can be achieved because of the straightening of the stacked sheet-shaped materials, especially if the sheet-shaped materials do not immediately land at the location provided on the flat stacking element.

Also according to the invention, at least two deflecting elements are mounted essentially symmetrical to the centerline of the transport movement. This may be a case of four or six deflecting elements, but alternatively an odd number of deflecting elements can also be provided that are arranged symmetrically to the centerline of the transport device.

In digital printing machines and copy machines, there are mainly two different concepts for guiding and alignment of sheet-shaped materials on their path along the transport path through the digital printing machine or the copy machine. One concept provides for an alignment of the sheet-shaped materials on one side edge that is the same for all formats of sheet-shaped materials that are processed with such a digital printing machine or copy machine. The other concept provides for guiding the sheet-shaped materials always centrally along the transport path through the digital printing machine or the copy machine, i.e. to provide an alignment with respect to the center line of the sheet-shaped material to the center line of the transport path that is the same for all formats of sheet-shaped materials that are processed with such a digital printing machine or copy machine. Both concepts have advantages and disadvantages. The latter concept is suitable for processing operations on the sheet-shaped material that are carried out symmetrically to the center line of the sheet-shaped material, say the application of a symmetrical hole pattern in the sheet-shaped material. Also, the lifting of one leading edge, especially in the area of the corners of a sheet-shaped material, may then be carried out if the deflecting elements are arranged symmetrically to the center line of the sheet-shaped material and even if the center line of the sheet-shaped material and the center line of the transport path lie on top of each other.

Also according to the invention, the deflecting elements are mounted to slide laterally and are in active connection with a threaded shaft with two opposing threads. By rotation of the threaded shaft, the position of the deflecting elements is changed transverse to the transport direction. If two deflecting elements are provided, whereby each one of the

deflecting elements is assigned to one of the threads of the threaded shaft, in this case the distance of the two deflecting elements from each other can be varied since the threads on the threaded shaft are opposing. Depending on the direction of rotation of the threaded shaft, the two deflecting elements get closer together or further apart from each other. If the two threads on the threaded shaft have the same pitch, the position of the deflecting elements changes in such a way that deflecting elements mounted symmetrically to the center line of the transport path continue to be arranged symmetrically to the center line of the transport path. However, it is within the scope of the invention to also provide threads with different pitches, which then can be used to change the distance between the deflecting elements and also a lateral displacement of the center point between the deflecting elements. This would be advantageous for alignment of the sheet-shaped materials at one side edge instead of to the centerline.

Also according to the invention, the outermost deflecting elements are mounted so that they can be moved depending on the dimensions of the sheet-shaped materials. The position of the deflecting elements changes depending on the dimensions of the sheet-shaped materials. The sheet-shaped materials that are used in a digital printing machine/copy machine or print further processing machine, of which the device according to the invention is a part, can have different width and length along the transport path so that different formats of the sheet-shaped materials may be processed or sheet-shaped materials with different orientation, such as portrait format or landscape format may move along the transport path. Both occur relatively frequently, especially in digital printing machines/copy machines or print further processing equipment since such devices typically already contain a large number of paper supplies or devices for changing the orientation of the sheet-shaped materials. This means many printers/copiers contain paper trays for paper of A3 and A4 as well as A4R format. It is advantageous if the position of the deflecting elements is adjusted to the respective format of the sheet-shaped materials. This can be achieved simply in that a control carries out a format-dependent adjustment of the position of the deflecting elements by controlling the rotation of the threaded shaft before receiving a sheet-shaped material on the sheet stack. In this process, the adjustment of the position of the deflecting elements can also be carried out in batches, i.e. before each order for the processing of sheet-shaped materials

with the same format. In this process, the control receives the information about the format, and thus the width of the sheet-shaped materials, either from the user, a higher-level control, sensors or other information sources.

Also according the invention, grooves are provided on the shaft that holds the deflecting elements, at specified positions by means of which the deflecting elements are mounted with exact position and reproducibly on the shaft. This may be carried out with an appropriate conical pin that is screwed into these grooves. An adaptation to a format change can also occur in that the pin is loosened, the deflecting element is slid to another groove provided for this along the shaft and then fixed with the pin at the new position so that it cannot slip.

Also according to the invention, the device has a measuring unit, by means of which the position of the outermost deflecting elements can be determined. This is in particular an optical sensor that specifies the zero position of the outermost deflecting elements. If there is a change in position of the outer deflecting elements, first the zero position is approached and after that the required position is approached. This may be necessary for a format change of the sheet-shaped materials to be stacked. Because of this, the process can be automated. This means, for example, a higher-level control can determine the format of the sheet-shaped materials to be stacked and automatically initiate the format change. By approaching the zero position, the positioning is calibrated each time. For instance, a lug can be provided as a sensing element on one of the deflecting elements, which runs through the optical sensor.

Also according to the invention, the device is used for stacking sheet-shaped materials that exhibit a hole pattern that is essentially parallel to the leading edge. In this case, the deflecting fin is arranged in the device according to the invention in the area of the outermost holes of the hole pattern so that the deflecting fins essentially cover these outermost holes of the hole pattern. Because the outermost holes of the hole pattern are covered, the risk previously described of "donkey ears" of a subsequent sheet-shaped material catching in the holes of the print material lying below it is prevented. The probability that a corner of a sheet-shaped material can catch in a hole of the hole pattern

of the print material lying below it depends on the lateral imprecision of the stack of sheet-shaped materials on the sheet stack. Since devices of this type generally are fairly precise, the problem is only notable in principle for the outermost hole of a hole pattern. Therefore, it is adequate to cover each of the outermost holes of a hole pattern to basically rule out catching of corners and holes. In this process, the deflecting elements are arranged in a preferred embodiment in such a way that when the sheet-shaped materials are stacked, the hole pattern lies behind the tip of the deflecting fin in transport direction, when the tip just touches the topmost sheet-shaped material in the stack. This prevents a lateral incoming sheet-shaped material from getting into the hole pattern of the topmost sheet-shaped material placed on the stack, since this is deflected upward by the deflecting elements before this happens.

The tip of the deflecting fin has a curve-shaped form, such as a semi-circle or at least an arc section, parabola-shaped curve or the like. This geometry further improves the deflecting behavior of the deflecting fins, since it prevents an incoming sheet-shaped material from bumping against a straight edge of the deflecting fin. The deflecting fin may have a symmetrical narrowing of the stop in the direction of the deflecting fin tip. An incoming sheet-shaped material that has run up to the deflecting fin, contacts the stop and now is being laterally aligned and exhibits a hole pattern of square holes in this area, will not catch, when moving laterally, on the deflecting fins with the edges of the square holes running parallel to the transport direction because of this symmetrical narrowing. The edges of a square hole can be slid smoothly onto the deflecting fin so that there is no tilting and the lateral alignment process can occur without problems.

Also according to the invention, a chamfer is embossed on the tip of the deflecting fin so that the tip of the deflecting fin offers a still smaller step for an incoming sheet-shaped material and there will be no tilting of leading edge of the sheet-shaped material. Damage to the leading edge of the incoming sheet-shaped material is reduced because of this.

Also according to the invention, at least one elastic driving fin is mounted so that it can rotate above the stack of sheet-shaped materials in such a way that during rotation of the driving fin, the end of the driving fin comes in contact with the topmost sheet-shaped

material on the stack and moves this topmost sheet-shaped material in transport direction. These types of driving fins are used for improved alignment of the sheet-shaped materials at a stop. The invention may have at least two driving fins, whereby at least one driving fin is more elastic and longer than at least one other driving fin. Two pairs of driving fins may be mounted alternately by 90° around a shaft. The driving fins consist in particular of silicone in order to achieve the desired elasticity and the necessary adhesion for driving the incoming sheet-shaped materials forward. Generally in this arrangement, only the long and more flexible driving fins come in contact with the incoming sheet-shaped materials. The short driving fins may be cut off in such a way that they only come in contact with sheet-shaped materials that may be distorted in the collecting area due to their stiffness and can not be optimally further transported by the longer driving fins to their end position above the stack of sheet-shaped materials.

Also according to the invention, at least one hold-down element, which can tip around a hold-down shaft and guide the next sheet-shaped material onto the stack of sheet-shaped materials, is mounted above the stack of sheet-shaped materials. There may be a plurality of hold-down elements that are distributed symmetrically to the centerline of the transport direction over the width of the sheet-shaped materials. The hold-down elements may exhibit counterweights that optimize the contact force on the sheet-shaped materials so that as little additional force as possible is necessary to overcome any friction forces that may occur between the hold-down elements and the incoming sheet-shaped material. Still enough force is applied to actually hold down the incoming sheet-shaped materials.

Also according to the invention, at least one hold-down element exhibits a hold-down lug that extends into a measuring unit, whereby the signal of the measuring unit is used to determine the height of the stack of sheet-shaped materials. The information on the stack height can be used in many ways, such as to check that all of the sheet-shaped materials of an order have arrive or in order to give a warning if the stack has reached its maximum height and must be taken out. Alternative measuring methods, such as capacitive or magnetic or other measuring methods that use electromagnetic waves or ultrasound of all different wavelengths, are considered as equivalent here.

Also according to the invention, the device exhibits a height-adjustable stacking element, on which the stack of sheet-shaped materials is formed, and a control, whereby the control uses the signal of the measuring unit in order to keep the position of the topmost sheet-shaped material essentially constant using the height-adjustable stacking element. Because of this, the height-adjustable stacking element and thus the stack will be lowered by the thickness of the incoming sheet-shaped material in accordance with the signal of the measuring unit after each incoming sheet. Because of this, the stop, which is provided with a radius, always remains optimally aligned to the incoming sheet-shaped materials. The same is true for the position of driving fins, that drive an incoming sheet-shaped material against such a stop, or even for the deflecting fins themselves and the deflecting elements. The height-adjustable stacking element can also be used to lower the stack of sheet-shaped materials below a fixed stop such that the stack can be removed in transport direction.

Brief Description of the Drawings

Fig. 1 a schematic side view of a first embodiment of the device according to the invention;

Fig. 2 a schematic top view of a first embodiment of the device according to the invention;

Fig. 3 a schematic side view of a second embodiment of the device according to the invention;

Fig. 4 a schematic top view of a second embodiment of the device according to the invention;

Fig. 5 a schematic partial side view of a third embodiment of the device according to the invention;

Fig. 6 a schematic partial top view of a third embodiment of the device according to the invention;

Fig. 7 a schematic, isometric partial view of the third embodiment of the device according to the invention;

Fig. 8 a schematic isometric enlargement of a detail of a third embodiment of the device according to the invention;

Detailed Description

Referring now to the drawings wherein like reference numerals designate like or corresponding parts throughout different views, there is shown in Figures 1 to 8 a schematic side view and/or schematic top view of three embodiments of the device 100, 100' according to the invention, whereby the components of the device marked with apostrophes indicate an alternate embodiment. Apart from this, the same reference characters designate the same elements in all figures. Drive and/or guide means and cams know to the person skilled in the art for operating the device are shown only schematically and/or are described in only a general way. Stepper motors are especially suitable as drives since their movement can be controlled precisely and in a simple way using control means known to the person skilled in the art.

The device 100, 100' according to the invention is part of a sheet-processing printing, copying or further processing device known to the person skilled in the art, especially part of a sheet-processing printing or further processing device such as is used to store sheet-shaped material.

As can be seen in Fig. 1, a sheet-shaped material 1 that will be stacked with edges even, is located on a transport path 2 marked with reference character 2, passing through a sheet-processing printing or print further processing device that is not shown. Along the transport path 2, the sheet-shaped material has a length that is identified with reference character 1' in Fig. 1. The sheet-shaped material 1 typically consists of paper with different sheet weight, or plastic films, or transparencies, or it can also be a mixture of papers and transparencies or a mixture of papers with different weights per surface area,

such as for the cover of a book in contrast to the pages of the book body, however, the outer edges of the sheet-shaped material that are collected in a sheet stack should essentially have the same dimensions. When sheet-shaped materials 1 are stacked with edges even in a following sheet stack, such as after the stacking of all the pages of a book to be bound, all the individual sheet-shaped materials 1 have essentially the same dimensions again. In any case, these essentially equal dimensions of the sheet-shaped materials 1 do not necessarily correspond to the essentially same dimensions of the sheet-shaped materials 1 of the preceding sheet stack since it can involve a new sheet format or a new page orientation.

The sheet-shaped materials 1 are guided and transported on the transport path 2, first by a first transport roller 12, which is mounted above transport path 2, and a second transport roller 22, which is mounted below transport path 2. Transport path 2 has a center line M1 that coincides with the centerline of the sheet-shaped materials 1 (see Fig. 2 or Fig. 4), irrespective of the format or alignment of sheet-shaped materials 1. With transport such as this, we speak of a centerline registration of the sheet-shaped materials 1. However, the device 100, 100' according to the invention is not restricted to the transport of sheet-shaped materials 1 with center line registration, sheet-shaped materials 1 that are registered along their side edges can also be stacked with side edges even using the device 100, 100' according to the invention. Instead of the transport rollers 12, 22, other transport elements that are not shown, but are known to the person skilled in the art, can be used, such as conveying bands or belts.

Below and in front of the two transport rollers 12, 22, a flat stacking element 50 is mounted. The flat stacking element 50 exhibits a length along transport path 2 that corresponds at least to length 1" of the largest sheet-shaped material 1 that is to be stacked. The flat stacking element 50 has guiding and bearing elements that are not shown but are known to the person skilled in the art, and drive and control systems which make a controlled, essentially vertical movement of the flat stacking element 50 possible. To facilitate the lateral removal of a sheet stack of sheet-shaped materials 1 from the flat stacking element 50, the flat stacking element 50 exhibits an angled slope 50' downstream.

Controller 70 controls the vertical position and the vertical movement of the flat stacking element 50, so that during the stacking of sheet-shaped materials 1, the upper edge of the sheet stack essentially has a constant height. To do this, the flat stacking element 50 drops, according to the thickness of the sheet-shaped materials 1 stacked, after each new sheet-shaped material 1 is stacked. Alternatively, controller 70 can also allow that the flat stacking element 50 will only be lowered after every nth sheet-shaped material. Controller 70 can contain an instruction, stored in a control logic that specifies a ratio between the sheet thickness and the number of sheet-shaped materials 1 to be stacked, after the stacking of which the flat stacking element will be lowered. Controller 70 receives information about the thickness of the sheet-shaped materials 1 from a user, a higher-level control, sensors or other information sources. In addition, controller 70 controls a longer, essentially vertical movement of the flat stacking element 50 in order to ensure a fast removal of the sheet stack.

The flat stacking element 50 is limited along transport path 2 by a stop 30 that can swing around a pivot point 31. As Fig. 2 shows, the stop is provided in duplicate in an arrangement symmetrical to centerline M1 of the transport path. This arrangement is advantageous, but not imperative for the device 100, 100' according to the invention, it is within the scope of the capabilities of the person skilled in the art to install this stop in a different number and/or arrangement. Stop 30 is mounted so that it can be swung around pivot point 30 in order to ensure a lateral removal of the sheet stack of sheet-shaped materials. Alternatively, an essentially vertical or horizontal movement is also conceivable within the scope of the invention in order to move the stop out of the way.

Above the flat stacking element 50, downstream of the two transport rollers 12, 22, a flexible driving fin 61 that can be driven in rotation is mounted on a shaft 60. In the embodiment, the driving fin 61 is fastened on shaft 60 such that it extends with uniform width on both sides of shaft 60. Alternatively, a larger number of individual driving fins 61 can also be provided, especially in order to create a different angular distribution on shaft 60. Alternatively, several similarly designed driving fins 61 are mounted along shaft 60 symmetrical to the center line M1 of transport path 2. Also, the driving fin 61 can also

be designed so that it is bent in a curved line. In this case, the direction of the curved line is opposite the rotation direction, marked with reference character 62, of driving fin 61 around shaft 60.

The driving fin 61 is arranged at a vertical distance from the upper edge of the sheet stack of sheet-shaped materials 1 so that during rotation around shaft 60 in the movement direction, marked with reference character 62, it comes in contact with the topmost sheet-shaped material 1 and during further rotation transports it further due to friction between the driving fin 61 and the sheet-shaped material 1 lying topmost on the sheet stack in transport direction. Driving fin material may be rubber-like or plastic-like material, or a coating on a comparable type of flexible material, such as a spring steel.

As soon as a sheet-shaped material 1 is slid by the first and second transport rollers 12, 22 far enough over the stacking element that it is located in the catchment area of driving fin 61, it is guided in a defined manner due to the friction contact with driving fin 61 and driven against stop 30. Driving fin 61 drops during further rotation around shaft 60 and the opposite fin of the driving fin can handle the next sheet-shaped material 1.

As soon as the trailing edge of the sheet-shaped material 1 leaves the area of contact with the first transport roller 12 and the second transport roller 22, the leading edge 6, 6' of the sheet-shaped material 1 moves, essentially unguided, to the flat stacking element 50 up to the point where driving fin 61 comes in contact with the topmost sheet-shaped material 1. Shortly before the trailing edge of the sheet-shaped material 1 leaves the area of contact with the first transport roller 12 and the second transport roller 22, the driving fin 61 is still not in contact with the sheet stack of sheet-shaped material 1, rather there is only a narrow gap between the end of the driving fin 61 and the topmost sheet-shaped material 1 that has already been stacked in alignment so that an arriving sheet-shaped material 1 can move forward under driving fin 61 far enough that driving fin 61 grasps it during rotation around shaft 60.

In the area of the leading edge 6, 6' of sheet-shaped materials 1, 1' on the sheet stack, two deflecting elements 82, 82' are mounted. In a first embodiment (reference characters

without apostrophe used for the components), the deflecting elements 82 exhibit a bent deflecting fin 83, which with its free end rests with light contact pressure on the stacking element 50 or on a sheet-shaped material 1, 1' already stacked on the stacking element 50. The deflecting fin 83 is curved in such a way that the concave part is open toward the sheet-shaped materials 1, 1' that have been delivered. This results in a deflection diagonal that points somewhat upward between the deflecting fin 83 and its base.

In the following, a first sheet-shaped material 1, which lies uppermost on the sheet stack, is indicated with a reference character without apostrophe, while on the other hand, a sheet-shaped material 1' to be stacked on top of it is designated with a reference character with apostrophe. The same is true for hole patterns 3, 3', the outermost holes 4, 4' of hole patterns 3, 3', the corners 5, 5' of the sheet-shaped materials 1, 1' and for the leading edges 6, 6' of the sheet-shaped materials 1, 1'.

The leading edge 6 of the first sheet-shaped material 1 glides on the stacking element 50 up to stop 30, in front of which the sheet-shaped material 1 comes to rest. Shortly before reaching stop 30, the leading edge 60 is guided onto the deflecting diagonal of the deflecting fin 83 and thereby slightly raised. After that, deflecting element 82 rotates 360°. As a result of this movement, deflecting fin 83 is pulled away laterally under the leading edge 6 of sheet-shaped material 1 so that the leading edge 6 of sheet-shaped material 1 is lowered vertically in front of stop 30. Then deflecting fin 83 is turned far enough so that it makes contact, coming from above, with sheet-shaped material 1 and possibly presses it completely on stacking element 50 if it has not already been completely lowered.

As Fig. 2 shows, lateral straighteners 41 are mounted on each side of the flat stacking element 50. Said straighteners 41 are brought in contact with the sheet stack by means of a movement in the direction of the arrow marked with reference character 42 and in doing so straighten the sheet stack laterally. In a preferred embodiment, the first or the second lateral straightener 41 is provided with elastic bristles (not shown) that compensate for elastic sheet tolerances during straightening. In this process, the bristles may be aligned at an angle of 45° to the plane of the flat stacking element 50, but other

angles are also conceivable. Likewise, in an alternative embodiment, one of the lateral straighteners 41 can exhibit a foam-like or other compressible surface. The other lateral straightener 41 is designed with a smooth, non-compressible surface.

First and second straighteners 41 are moved synchronously toward and away from the sheet stack by a controller 70 so that an optimum lateral alignment of the sheet-shaped materials 1 in the sheet stack is achieved. The synchronous movement of the lateral straighteners 41 occurs in cycles after each individual sheet-shaped material is stacked. The movement is triggered precisely after the driving fin 61 has pushed the newly stacked sheet-shaped material 1 against stop 30 and the leading edge 6 of the sheet-shaped material is located on the free end of the deflecting fin 83.

The next sheet-shaped material 1' is pushed in the same manner as the preceding sheet-shaped material 1 by the driving fin 61 against stop 30 and in turn the leading edge 6' of the second sheet-shaped material 1' is lifted by the deflecting fin 83 prior to reaching stop 30. Because of the lifting of leading edge 6', it is possible to prevent, even with a misalignment of corners 5' of the leading edge 6' of the second sheet-shaped material 1 as is shown in Fig. 2, corner 5' from getting caught in hole pattern 3, and in particular, in the outermost hole 4 of hole pattern 3 of the first sheet-shaped material 1.

After the lateral alignment of the second sheet-shaped material 1', the deflecting element 82 rotates 360° around its axis again, whereby deflecting fin 83 is pulled out laterally from under the leading edge 6' of the second sheet-shaped material 1' so that the leading edge 6' of sheet-shaped material 1' lowers vertically in front of stop 30, onto first sheet-shaped material 1 with its side edge even. Then deflecting fin 83 is rotated far enough that it now comes in contact, from above, with sheet-shaped material 1' and presses this down completely on the first sheet-shaped material 1 if necessary, if the second sheet-shaped material 1' has not already dropped completely.

During rotation of the deflecting element 82, the first sheet-shaped material 1 can be pushed again, depending on the surface finish of deflecting fin 83, against the stop

simultaneously, especially if the underside of deflecting fin 83, which faces first sheet-shaped material 1, has a higher friction, as was already described above.

Fig. 3 and Fig. 4 show a second embodiment of the device 100' according to the invention. It differs in that, instead of a single bent deflecting fin 83, the deflecting element 82' exhibits two straight deflecting fins 83' and deflecting element 82' is arranged essentially behind stop 30 in transport direction. The free end of one of the deflecting fins 83' in turn lies in the area of the leading edges 6, 6' of sheet-shaped materials 1, 1'. In addition, the deflecting fins 83' are positioned at a slight angle with regard to the plane of stacking element 50 so that a slight deflecting diagonal occurs here that can deflect, upward, the leading edge 6, 6' of a sheet-shaped material 1, 1' that comes in laterally.

The procedure of deflecting the arriving sheet-shaped materials 1, 1' and the rotating of deflecting element 82, 82' repeats for each sheet-shaped material 1 to be stacked in both embodiments of the device 100, 100' according to the invention. Once the last sheet-shaped material 1, 1' lies on the sheet stack, the lateral straighteners 41 are brought into position in contact with the sheet stack, for the lowering of the flat stacking element, so that together with stop 30, a multi-sided guiding of the sheet stack is ensured during the fast lowering. The lateral straighteners 41 are also moved in this process.

In the embodiment shown of the device 100' according to the invention, the deflecting fins are designed so that they are relatively wide and are placed so that they completely cover at least the outermost hole 4, 4' of hole pattern 3, 3' in the sheet-shaped material 1, 1' and thus additionally prevent a catching of corners 5, 5' and the outer holes 4, 4' of the different sheet-shaped materials 1, 1'. Other combinations of width, curve form and number of deflecting fins 83, 83' on the deflecting elements 82, 82' may be utilized.

Both embodiments of the device 100, 100' according to the invention have in common the fact that the deflecting elements, as shown in Fig. 1 and Fig. 3, are actively connected to a threaded shaft 80, 80' by way of a coupling 85, 85'. This threaded shaft 80, 80' exhibits two opposing threads 81, 81', on which nuts, run that are secured against turning

and have a non-slip connection with the bearings of deflecting elements 82, 82', in each case. By rotation of threaded shaft 80, 80', the deflecting elements 82, 82' are slid symmetrically to the centerline of transport path 2, inward or outward, depending on the direction of rotation of threaded shaft 80, 80'. In particular, the position of deflecting elements 82, 82' changes relative to the centerline of transport path 2, automatically to the optimum position for the form of the sheet-shaped materials to be stacked.

This optimum position is derived from the width of the deflecting fin 83, 83', from the distance of the outermost holes 4, 4' from the corners 5, 5' of sheet-shaped materials 1, 1', from the width of the sheet-shaped materials 1, 1', etc.

The automatic sliding of deflecting elements 82, 82' allows the controller 70 to control the drive of the rotation of threaded shaft 80, 80' according to different specifications. The specifications may be instructions that controller 70 receives from a user, a higher-level control or sensors with regard to the format of the sheet-shaped materials 1, 1' to be stacked.

Figs. 5 to 8 show further details of an embodiment of the device according to the invention, namely in particular the hold-down elements 90, the driving fins 61, and an embodiment of the side elements 82a, 82b of deflecting elements 82 and a special embodiment of deflecting fins 83.

In this embodiment, stop 30 is fixed, while the stacking element 50 is mounted so that it can move vertically, as is indicated by the arrow 52 in Fig. 5. In the area of the upper edge of the stack of sheet-shaped materials 1 collected on the stacking element 50 and, above all in the area of the deflecting fins, stop 30 exhibits a radius 32 that represents a leading edge stop mounted out front for the incoming sheet-shaped material 1'.

In this embodiment, six deflecting elements 82 are mounted on a hexagonal shaft 89, essentially symmetrical to centerline M1 of transport direction 2. The outer deflecting elements 82 are connected to threaded shaft 80 by way of couplings 85 and their positions can be changed on both sides at the same time. In this embodiment, the sliding

of the outer deflecting elements 82 is also carried symmetrically to centerline M1 of transport direction 2. At least one of the outer deflecting elements 82 has a lug 105 that can extend into a measuring unit 110. The measuring unit in this embodiment is an optical sensor 110, in particular a photoelectric barrier 110 that determines the zero position of the outer deflecting elements 82. If a change is made to the positions of the outer deflecting elements 82, the outer deflecting elements 82 first are moved to the zero position in order to then be moved to the desired position. The desired position can be reached using the control of the steps of a stepper motor that is not shown, which drives threaded shaft 80. In this way, the exact position of the outer deflecting elements 82 is ensured. In the embodiment shown in Figures 5 to 8, both outer deflecting elements 82 have a lug 105, however only one of the lugs 105 has a function.

In the embodiment shown in Figures 5 to 8, the deflecting elements 82 consist of a deflecting fin 83 and side elements 82a, 82b. In Fig. 8, one side element 82a is not shown so that the shape of deflecting fin 83 can be shown better. The deflecting fins 83 are bent spring steel plates that are fastened on one side to the hexagonal shaft. In their centers, deflecting fins 83 have slots 83b. A pin (not shown), with which the inner, immobile deflecting elements 82 are fastened to the hexagonal shaft 89 so that they cannot slip, runs through this slot. These pins that are not shown are centered at grooves 89' in hexagonal shaft 89 shown in Fig. 8. These grooves 89' are provided at different locations of the hexagonal shaft 89, which in part correspond to different formats of sheet-shaped materials 1, say US or DIN format. A change between these formats is thus also possible, but requires operator intervention.

The geometry of deflecting fins 83 exhibits a narrowing toward the free end 83a, and ends in an arc-shaped tip 83a. An incoming sheet-shaped material 1', which has run onto deflecting fin 83, touches stop 30 and is now aligned laterally and has a hole pattern 3 of square holes in this area, will not catch with the edges of the square holes on the deflecting fins 83 during a lateral movement, due to this symmetrical narrowing of deflecting fin 83. The edges of a square hole can be slid laterally much more smoothly on deflecting fin 83 so that there will be no catching and the lateral aligning procedure can be carried out without problems.

A chamfer is embossed on the tip 83a of deflecting fin 83 so that tip 83a of deflecting fin 83 offers a still lower level for incoming sheet-shaped material 1 and there will be no catching with the leading edge of the incoming sheet-shaped material 1. This reduces damage to the leading edge of an incoming sheet-shaped material 1. The embossing may be about a few 100 μm wide and runs parallel to the hexagonal shaft 89.

Side elements 82a, 82b are present in two different versions in the embodiment shown. What both embodiments of side elements 82a, 82b have in common is that they are essentially disk-shaped. Side elements 82a, 82b have a surface 86, the majority of which is aligned and thereby is similar overall to a roller cut into disks. Side elements 82a, 82b may be made of injection-molded material and are as lightweight as possible. For weight reduction, side elements 82a, 82b may exhibit concentric holes.

All side elements 82a, 82b have a tab 87 (cf. Fig. 5) following the deflecting fin 83 in rotation direction of the deflecting element 82, the dimensions of which prevent a spreading of the sheet-shaped materials 1 already stacked in the area of the leading edges of sheet-shaped materials 1. Because of this tab 87, the spatial separation between the stack and an incoming sheet-shaped material 1' is ensured in this area. Side elements 82a, 82b differ in the area in which the deflecting fins 83 are mounted in the basic position of deflecting elements 82 above tip 83a of deflecting fins 83. In this area, side elements 82a have a vertical stop 86' that guides the incoming sheet-shaped materials 1' against stop 31 and prevents an upward spreading of the leading edges. This means that sheet-shaped materials 1 that have a certain "curl" can also be guided precisely to stop 30. Side elements 82b, on the other hand, exhibit a recess 86" in this area. The recess 86" is provided to prevent the outside edges of a sheet-shaped material 1 from colliding with side elements 82b during lateral alignment. In the embodiment shown, side elements 82a are provided on both sides for the two innermost deflecting elements 82 lying closest to the center line M1 of transport path 2. On the four deflecting elements 82 mounted further toward the outside, the side elements 82a are provided with the vertical stop surface 86' on the side of deflecting fins 83 turned toward center line M1 of transport path 2 and on the side of the deflecting fins 83 turned away from the center line M1 of

the transport path 2 are side elements 82b with recess 86". With this arrangement, a recess 86" remains at the critical locations and simultaneously over the entire width of sheet-shaped material 1, there is a vertical stop 86' that improves the alignment of the incoming sheet-shaped materials 1'.

Side elements 82a that have vertical stop 86' also have a leading edge stop 88, which is shaped as a circular section and is essentially congruent with the radius 32 of stop 30, and mounted a few 100 µm behind radius 32 of stop 30 in transport direction. This leading edge stop 88 carries out a first rough alignment of the incoming sheet-shaped materials 1'. Both vertical stop 86' and leading edge stop 88 are located in their functional position when the deflecting fin 83 lies on the topmost sheet-shaped material 1 of the stack in order to deflect an incoming sheet-shaped material 1.

In the embodiments shown in Figs. 5 – 8, the driving fins 61, 61a, 61b are designed in different lengths. In this case, there are two pairs of driving fins 61a, 61b that are mounted on shaft 60, alternately by 90°. The material of the driving fins 61a, 61b is silicon in order to achieve the desired elasticity and the necessary adhesion for driving the incoming sheet-shaped materials forward. With normal papers, only the long and more flexible driving fins 61b come in contact with the incoming sheet-shaped material 1'. The short driving fins 61a with greater bending stiffness are cut off in such a way that they only come in contact with sheet-shaped material 1 that become distorted in the collecting area due to their stiffness and can not always be optimally driven against stop 30, 32 by the longer driving fins 61b above the stack of sheet-shaped materials 1.

Above the stack of sheet-shaped materials, hold-down elements 90 are mounted so that they can tip around a hold-down shaft 91 and guide the incoming sheet-shaped material 1' onto the stack of sheet-shaped materials 1. The hold-down elements 90 are distributed, symmetrical to centerline M1 of transport direction 2, over the width of the sheet-shaped materials 1. At the free end, the outer hold-down elements are provided with counterweights 92 in order to optimize the contact force on the sheet-shaped materials 1 so that as little additional force as possible is necessary to overcome any friction forces that occur between hold-down elements 90 and the incoming sheet-shaped material 1'.

The center hold-down element 90 exhibits a hold-down lug 93 (Fig. 5), which extends into a measuring unit 94. The measuring unit 94 is an optical sensor, especially a photoelectric barrier 94. The signal from photoelectric barrier 94 is used to determine the stack height of the sheet-shaped materials 1. The photoelectric barrier 94 is connected to controller 70, which controls the height-adjustable stacking element 50 with a control circuit in order to keep the position of each topmost sheet-shaped material 1 essentially constant. Because of this, the height-adjustable stacking element, and thus the stack is lowered by the thickness of the incoming sheet-shaped material 1' according to the signal of photoelectric barrier 94 after each incoming sheet-shaped material 1'. Stop 30 is provided with a radius 32, always remains aligned optimally to the incoming sheet-shaped materials 1'. The same is true of the position of driving fins 61, 61a, 61b that drive an incoming sheet-shaped material 1' against such a stop 30, 32 or also for the deflecting fin 83 and deflecting elements 82.

The outer hold-down elements 90 are mounted so that they are aligned with driving fins 61, 61a, 61 b in transport direction 2 and in the area of driving fins 61, 61a, 61b exhibit hold-down tabs 95 on both sides of driving fins 61, 61a, 61b (see Fig. 6 and Fig. 7). The ends of the hold-down elements 90 are rounded to reduce the friction between hold-down elements 90 and incoming sheet-shaped materials 1' and to prevent damage from occurring to the incoming sheet-shaped materials 1'. The contact points of hold-down elements 90 lie on a common imaginary line.

A movable trailing edge straightener 99 is provided below the second transport roller 22, see Fig. 5.

Although the invention has been shown and described with exemplary embodiments thereof, it should be understood by those skilled in the art that the foregoing and various other changes, additions and omissions may be made therein and thereto without departing from the spirit and scope of the invention.